NON - MARKET POLICY INSTRUMENT OPTIONS FOR REDUCED GHG EMISSIONS FROM AGRICULTURE

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SUMMARY

Non-market policy options for reduced greenhouse gas (GHG) emissions include voluntary programming initiatives, financial incentives, and prescriptive standards. These options have often been praised for eliminating the least efficient products from the market, but have also been criticized for not improving the efficiency of all products in the marketplace (Rolfe, 1998). Even so, one cannot deny that non-market policy instruments have a primary role to play in environmental protection in Canada. However, the use of these instruments in the agriculture sector does not provide a complete solution to reducing GHG emissions. They must be used in conjunction with market-based instruments if efficient solutions are to be found.

1. INTRODUCTION

The use of market and non-market policy instruments to control and correct problems of the environment has increased in recent decades. Block (1990) states that the reconciliation of economics and the environment will come through the use of economic means to achieve environmental ends. This paper looks specifically at legal and economic aspects of non-market policy instruments that can be used to achieve GHG emission reductions in the agricultural sector.

1.1 Objective

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The objective of this paper is to outline the nature of non-market policy options to control GHG emissions from agriculture. The paper provides an overview of behaviour that will enhance GHG emission reductions in agriculture, examines non-market policy instruments that will encourage environmentally sound behaviour, canvasses legal questions relevant to the implementation of such instruments, and identifies areas where further research is required. This policy paper is designed to be a brief, analytical account suitable for policy makers, interdisciplinary researchers and the general public.

1.2 Terms of reference

Only non-market policy options will be examined in this paper. Therefore, it is necessary to determine the theoretical division between non-market and market policy options. Market-based instruments promote the creation or improvement of a market in order to address problems of market failure; in contrast, non-market instruments tend to influence polluter behaviour through mechanisms that are not determined by the free choice of buyers and sellers (Larrue, 1995). That is, they only indirectly influence individual or collective perceptions of costs and benefits. Non-market instruments result from direct governmental intervention to change producer behaviour by either encouraging new practices or discouraging old ones. In legal terms, a government may alter property rights regimes, proscribe practices, or offer monetary incentives to adopt new practices.

Non-market instruments can take a variety of forms. They can be broadly collected into three groups, each requiring varying degrees of governmental intervention; (1) voluntary programming initiatives, (2) financial incentives and taxes, and (3) prescriptive standards (Rolfe, 1998). This report examines each of these below. However, before doing so it is essential to set out practices that are likely to bring about GHG emission reductions in agriculture.

2. REDUCING GHG EMISSIONS IN AGRICULTURE

GHG emissions from agriculture include methane from the digestion processes of animals and the decomposition of manure; nitrogen emitted from soils due to the use of nitrogen

fertilizers and the production of legume crops; and carbon dioxide (CO2) that results from the manufacture and use of inputs such as fuel and fertilizers (Coxworth, 1997). Agricultural soils can be either a source of CO2 through loss of organic matter due to cultivation (Boehm, 1992; Anderson, 1995), or a sink for carbon via the restoration of degraded soils and the adoption of soil conservation practices (Bruce *et al.* 1998). Consequently, two ways by which producers can potentially reduce GHG emissions from agriculture are through the reduction of direct energy use, and by increasing the capacity of soils as carbon sinks.

2.1 Reduced energy use

Technological advancements in the areas of fuel efficient farm equipment, improved diets for ruminant animals, and more efficient use of synthetic fertilizers can potentially decrease direct GHG emissions from agriculture. Andersen (1994) suggests two primary classifications of technologies that can be used to remedy environmental problems; removal and prevention technologies. Removal technologies are things such as dilution and end-of-pipe technologies while prevention technologies include clean technology and structural strategies. Most governments now advocate the use of cleaner technologies, such as energy efficiency and recycling, which can be promoted through the use of non-market instruments.

Land use changes can also potentially reduce direct energy emissions from agriculture. Conservation and zero-tillage reduce the use of fuel while protecting soil from erosion even though they may require more indirect energy inputs, such as fertilizers and herbicides (Soil Works, 1998a). Such land use changes can be encouraged through new property rights such as conservation easements (Annand, 1998; Kwasniak, 1997; Loukidelis, 1992).

2.2 Increased carbon sinks

Soil organic matter is a source sink for carbon in the cycling of CO2 (Gregorich *et al.*, 1995). Consequently, the release of CO2 from cultivation of agricultural land has greatly contributed to the present atmospheric concentration of CO2 (Boehm, 1992). Land management practices, such as tillage methods and crop rotations, directly affect soil organic matter levels (Gregorich *et al.*, 1995). Bruce *et al.* (1998) indicate four broad approaches that can be used to

increase carbon levels in cultivated soils; (1) reduction in tillage intensity, (2) cropping system intensification, (3) use of yield-promoting practices (such as improved nutrient modification), and (4) the reestablishment of permanent perennial vegetation.

There are new technologies, such as zero-tillage and direct seeding, that may help to increase the carbon sequestration capacity of agricultural soils by improving organic matter levels. The use of mechanical tillage and the inclusion of summerfallow in crop rotations have contributed to the loss of organic matter in the past (Andersen, 1988, 1995; Acton and Gregorich, 1995). However, modern agricultural methods are returning carbon to previously carbon-depleted soils (Anderson, 1995). The trend in organic matter decline can be reversed, and soil quality improved, through the use of extended crop rotations, fertilizer application based on soil test results, and the use of stubble mulch tillage (Biederbeck *et al.*, 1984).

Another land use option that can be used to sequester carbon in soils is the increased production of forage crops. Perennial forages add more organic matter to soil than most annual crops; therefore, the use of forages can improve the carbon sequestration capacity of marginal agricultural soils. The Prairie Farm Rehabilitation Administration (PFRA) provides information on topics such as harvesting, bloat management, and pest management of forage crops on its Internet site (PFRA, 1998). Two other online publications that deal with the economics of conservation fallow and the economics of zero tillage are the *Soil Works* publications, which include interactive worksheets designed to demonstrate the economic considerations of either of these two systems (Soil Works, 1998a, b). Environment Canada advocates actions such as the reduction of fallow, longer crop rotations, improved crop yields, and increased forage production to maintain and increase the carbon content of agricultural soils (Environment Canada, 1995).

3. VOLUNTARY PROGRAMMING INITIATIVES

Voluntary programming initiatives include programmes to educate producers and consumers, to establish relationships between producers and consumers to encourage 'green' consumer patterns, and to establish agreements between governments and producers regarding production processes to encourage environmentally sound practices.

3.1 Educating producers and consumers to reduce GHG emissions

One of the primary non-market vehicles for changing behaviour to encourage practices aimed at GHG emission reductions is education. Various private corporations and public companies publish reports that reveal their environmental practices and that deal with issues such as how individuals can increase their energy efficiency and decrease harmful emissions.

Oil and gas companies, along with utility companies, are among the greatest emitters of CO2. Energy used in the production of oil and gas and use of the products both greatly contribute to GHG emissions. Imperial Oil, Shell Canada, and Petro-Canada, among others, publish online information concerning their environmental practices and commitments, and technological advances that can reduce emissions (Imperial Oil, 1998; Petro-Canada, 1998; Shell, 1998). The Canadian Energy Pipeline Association (CEPA) also includes a section on climate change on their Internet site; CEPA was one of the first industry associations to sign a memorandum of understanding in support of the Canadian Voluntary Climate Change Challenge Program and Registry (CEPA, 1998). SaskPower includes a list of accessible publications on its Internet site, including copies of the *Climate Change Action Plan* and the *1997 Environmental Review* (SaskPower, 1998). The Canadian Gas Association (CGA) includes a home energy checklist and winter heating tips to its online visitors (CGA, 1998).

There are also private not-for-profit organizations that exist to help to educate people about legal and environmental problems, and to provide solutions for these problems. Two such organizations are the Environmental Law Centre (ELC) in Edmonton and the West Coast Environmental Law Association in Vancouver. The ELC is an independent, charitable non-profit organization that helps to bring a legal perspective to environmental problems (ELC, 1998). The ELC provides online reports and has an extensive catalogue available on its Internet site. The West Coast Environmental Law Association also publishes in the area of the legal regulation of environmental practices (Rolfe, 1998; Rolfe and Nowlan, 1993).

Public organizations, such as universities and government departments, release numerous articles each year concerning the use of energy and improvements in energy efficiency. Once again the Internet is an important source of information. The

Office of Energy Efficiency (OEE) has a virtual library of energy publications on its Internet site, and includes links to articles regarding regulations and statistics in addition to access to its own publications (NRCan, 1998). Environment Canada has a program entitled *Canada's National Environmental Indicator Series;* environmental indicators are key statistics focused on trends in environmental changes and are useful to decision-makers because they deliver concise, credible information that is easily understood (Environment Canada, 1998a). The Canadian Government also has an Internet site that allows visitors to access information, calculate their own CO2 emissions, and learn more about increasing their energy efficiency at home and at work (Government of Canada, 1998). Environment Canada's *The Green Lane* Internet site contains information on climate change the state of the environment, news releases, and environmental priorities (Environment Canada, 1998b).

There is a great amount information specifically focused on GHG emissions from agriculture and how to increase on-farm energy efficiency that is available from provincial organizations such as Saskatchewan Agriculture and Food (SAF), and national organizations such as the Canadian Agricultural Energy End-use Data Analysis Centre (CAEEDAC) at the University of Saskatchewan. SAF includes an online section on environment and habitat that includes information on the Environmental Technology Loan Fund, and the Friends of the Environment Foundation (SAF, 1998). CAEEDAC maintains several online databases such as the Provincial Agricultural Energy Datatbase, and data from Statistics Canada, as well as data from provincial and private agencies that pertains to farm machinery use and maintenance, and general energy data (CAEEDAC, 1998).

CAEEDAC, in conjunction with the Agricultural Institute for Management in Saskatchewan (AIMS), the Centre for Studies in Agriculture, Law and the Environment (CSALE), and the Department of Agricultural Economics at the University of Saskatchewan, is in the process of developing an interactive CD-ROM for producers. This CD-Rom will allow primary agricultural producers to make a preliminary evaluation of their energy use and resultant GHG emissions. After inputting their personal data using the CD-ROM, the producer will be able to compare their energy use to area averages for similar production operations. Facts and advice relating to various issues, such as zero-tillage, will be available to the producer through the use of the CD-ROM. This CD-ROM will be available to producers by sale through various outlets, such as elevators and farm service centres and, potentially, the

program will be accessible from the Internet.

3.2 Establishing 'green' relationships between producers and consumers

This non-market policy initiative is sometimes referred to as 'procurement programmes' whereby governments and/or consumer groups organize to develop a demand for products that have been produced in an environmentally friendly fashion (Rolfe, 1998). By agreeing to purchase a new product, usually at a premium price, in quantities sufficient to encourage economically viable production levels, consumers can influence production methods. Two programmes where this type of voluntary agreement might be applicable to agriculture would be in the production and purchase of ethanol-based fuels and GHG friendly foods. However, the production and sale of GHG friendly foods may entail substantial obstacles with respect to definition, development, and certification.

3.3 Establishing agreements between producers and governments

Agreements can be made between these two groups that encourage production processes that are based on environmentally sound practices. This type of policy contemplates the use of non-binding agreements, covenants, and challenges among producers and government to reduce GHG emissions. Under these agreements, various associations, such as the Saskatchewan Soil Conservation Association, might agree to adopt measures that will result in a certain level of GHG emission reductions by a specific date. These measures would likely be restricted to those that would have limited negative effects on production costs ('no-regrets' policies), or would be attempts to stave off more drastic governmental measures such as taxes or other, more prescriptive, standards.

4. ENCOURAGING GHG EMISSION REDUCTIONS IN AGRICULTURE

This section identifies non-market instrument options for controlling and reducing GHG emissions, from the most restrictive "stick" options of governmental prohibitions, regulations and standards to less restrictive "carrot" options of taxes and green subsidies.

4.1 "Stick" approaches

"Stick" approaches are at the basis of all government intervention procedures to reduce GHG emissions. Prescriptive

standards are necessary to ground the operation of market instruments that give effect to emission trading schemes. However, non-market options may also involve prescriptive standards that tend to control the most obvious and grievous violations of unsound practices and, as such, are often applied across the board. This can result in inequities in implementation costs and rarely encourages innovation beyond the standard prescribed. In the agricultural sector, such standards may include set-aside programmes for marginal land or minimum fuel-efficiency standards for farm machinery.

4.2 "Carrot" approaches

Non-market economic approaches, other than prescriptive standards, commonly refer to financial incentives used to correct environmental problems. Economists have long stressed the advantages of economic approaches to pollution control (Ingham, 1993). Modern governments are using more economic instruments, primarily because traditional command and control instruments have failed to correct environmental problems.

The use of carbon and energy taxes would be directly applicable to agriculture. Although not widely accepted in America, these taxes have gained importance in some European countries. Hoerner and Muller (1996) found them to be among the most promising and important tools available for promoting the reduction of CO2 emissions. Andersen (1994) looks at twenty years of environmental experiences to test the use of economic instruments used to solve environmental problems. He compares the water policies of Denmark, France, Germany, and the Netherlands to show that, in contrast to administrative regulation, green taxes have made pollution prevention pay and have promoted the 'ecological modernization' of industry.

Ingham *et al.* (1991) focussed on the empirical measures of carbon taxes. They found that the level of taxes and costs of reducing CO2 emissions greatly depend on the time-scale that economic agents are given to meet targets. The authors in Block (1990) argue that by using economic instruments such as free market prices, private property rights, and a legal system that defines, delineates, and protects those rights, environmental goals can be achieved. However, property rights, scientific uncertainties, transportation problems, and transaction costs can impede the use of economic instruments to solve environmental problems (Dolan, 1990).

The reduction of atmospheric carbon levels is an important objective, not just for the politicians who have agreed to do so, but for the benefit of society as well. Although at first

glance a fossil fuel tax may appear to be a logical choice by which to reduce carbon emissions, the agricultural production process is too complex to assume that an across-the -board tax will reduce CO2 emissions from the agricultural sector of the economy (Edwards, 1998). The complication arises because a tax on all fossil fuels would increase the price of synthetic fertilizers. This in turn would reduce fertilizer use more than a price increase in diesel fuel or gasoline would reduce its use because fertilizer has a higher elasticity of demand than fuel (Yildirim *et al.*,1995). Therefore, a tax that would increase both direct (fuel) and indirect (fertilizer) energy prices could potentially lead to increased summerfallow acreage and decreased fertilizer use, which, as previously mentioned, could decrease the potential for agricultural soils to sequester carbon.

With respect to subsidization of 'green' programs, possibility exists for various options in the agriculture industry. The subsidization of cleaner burning fuels, such as ethanol, would promote both its use, and the development of new technologies in farm machinery that would use cleaner burning fuels. However, the first step to reduced carbon emissions should logically be the removal of current subsidies and tax exemptions on farm fuel, such as those available under the Saskatchewan Farm Fuel Program. Subsidies could also be used to promote the use of zero tillage and direct seeding in order to improve carbon sequestration. A per acre benefit could also be an incentive to put marginal land under permanent cover, once again resulting in carbon sequestration. Subsidies on feed development and manure handling facility development could encourage livestock producers to adopt more efficient production methods to reduce methane emissions from the livestock sector.

The use of taxes and subsidies in agriculture is a complex decision to be made by policy makers. Differences in supply and demand elasticities of agricultural inputs and products affect the costs and benefits of these instruments. Policy makers must be cautious when choosing to implement taxes or subsidies and must bear in mind the level of taxation (subsidization), time considerations, and possible exemptions from either taxes or subsidies.

5. LEGAL CONSIDERATIONS

Similar legal considerations in the implementation of non-market and market options will have to be contemplated given Canada's complex constitutional division of powers between the

federal and provincial governments (Hogg, 1997). The federal government is clearly incapable, for constitutional reasons, of implementing a comprehensive package of measures that would reduce GHG emissions in agriculture (Rolfe, 1998). Of course, some aspects of the federal government's overall program, such as the voluntary programming initiatives explored above, could be achieved without any legislative acts. Furthermore, through a national action plan developed jointly with provincial governments, certain aspects of the plan could be coordinated with provincial actions destined to achieve effects similar to those legislated at the federal level.

With respect to financial incentives and prescriptive standards, new legislation would be necessary and would be subject to constitutional scrutiny. Provinces can impose direct taxes on fuels and provide rebates or subsidies to producers who buy emission-reducing farm machinery, but could not levy indirect taxes to reduce fuel use by, for example, a tax on fertilizer production. The federal government could introduce a comprehensive plan to implement a prescriptive cap on emissions but could not implement how land must be used to achieve that cap. Thus the federal 'peace, order, and good government', the criminal law power, and the trade and commerce power of the *Constitution Act, 1867* would clothe the federal government with significant jurisdiction to create non-market instruments, but could not be used to override the province's principal head of jurisdiction over property and civil rights. Furthermore, legal implementation would have to take into consideration Canada's obligations under its international agreements such as WTO and the NAFTA (Charnovitz, 1991; Demaret and Stewardson, 1994; Johnson and Beaulieu, 1996).

6. OPTION EFFECTIVENESS AND FURTHER RESEARCH

Implementing any of the non-market instruments mentioned in this paper will produce varying welfare effects. Taxes increase the price of a good, therefore reducing demand for that good (assuming normal goods); consumers lose because of the higher priced goods, although society may benefit from the increase in tax revenue. Subsidies have the opposite impact, as prices are essentially lowered to those who are eligible to receive the subsidy. As price decreases, demand for the good will increase. The welfare gain or loss of either does, however, depend on the substitutability among goods and the elasticity of demand. Voluntary programming initiatives will produce less profound welfare effects. Thus, to determine which non-market instruments might most effectively be

employed to develop behaviour that leads to GHG emission reductions in agriculture, an evaluation method or model must be developed. Further research will be required to determine how to compare the effectiveness of one instrument over another.

Further research on the constitutional difficulties that will arise from the implementation of non-market instruments, by either the federal or provincial level of government, is also necessary. The history of Canadian marketing and environmental legislation has shown how difficult the constitutional division of powers is to negotiate when matters appear to require cooperation from both levels of government.

Finally, the use of non-market policy instruments does not provide a complete solution to problems concerning the reduction of GHG emissions. They must be used in conjunction with market-based instruments if efficient solutions are to be found. Most economists have faith in the assumption that economic instruments would be more cost-effective than regulatory policies (Esty and Geradin, 1998). However, further research is necessary to determine how the two types of instruments, and the institutional arrangements used to implement them, can be used effectively in concert to achieve maximum impact for the reduction of GHG emissions in the agricultural sector.

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